

SCIENCE

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IDEALS OF MEDICAL EDUCATION.¹

WHEN the medical faculty of an ancient, famous, and progressive university honors a physician by a request that he will deliver an address to it, and to its friends, upon such an occasion as this, the subject of that address must be sought within certain limits. It should have some relation to the special work of the faculty,—to medical education as it was, or is, or should be. The fact that you have already had three addresses bearing on this subject by distinguished medical teachers, who are more familiar with its practical bearings and needs than I can be, does not authorize me to try another field, although it greatly increases my difficulty in selecting reflections and suggestions which are suited to the occasion and to the audience, and which, at the same time, will not be a wearisome repetition of what is already familiar to you. I know, however, that discourses of this kind are soon forgotten: were it otherwise, this would indeed be a hard world for address givers.

Of course the medical department of Yale is organized in the best possible manner, and is doing the best possible work, under the circumstances. I do not know precisely what its organization is, or work it is doing, or the exact circumstances which govern it, but I have no doubt it is safe to assume this. There is one circumstance, however, which very commonly affects medical schools and universities, and which therefore may possibly affect you, and that is, the want of means to do every thing that anybody may consider desirable. Perhaps, then, some remarks upon certain modern ideals of medical education, and upon first-class medical schools and their cost, based upon data derived from other schools, may be of some interest, especially in the light of Rouchefoucauld's aphorism that there is something in the misfortunes of our best friends which is not displeasing to us.

The great mass of the public—the majority of the voters of all parties, and of the women who are not voters—know little and care less about the details of professional education, or about the standard of qualification attained to by those to whom they intrust more or less of the care of their souls, their property, or their bodies. The popular feeling is that in a free country every one should have the right to follow any occupation he likes, and employ for any purpose any one whom he selects, and that each party must take the consequences.

It is noteworthy, however, that each individual professing to hold this opinion almost always makes an exception to his own occupation if it is one involving skilled labor. He is in favor of free trade in the abstract, and of limitations with regard to his own particular trade, either as to number of apprentices, as to time of study, or as to some form of trust which will prevent, as far as possible, competition in that special business. In one of its aspects, medicine is a trade, carried on for the purpose of making money in order

to support the physician and his family; and to the majority of practitioners this is a very important aspect, although to very few of them is it the only one. Hence it is that medical faculties must consider schemes of medical education from this point of view also; not exclusively so by any means, but, nevertheless, with reference to the questions: What do we propose to offer? How much will it cost us? How much shall we charge for it? With reference to the first question, it is obvious that there are several quite different kinds of education which a medical faculty may offer to its students. It is by no means easy to decide as to the quality and quantity of the article offered by consulting only the advertisements, circulars, and prospectuses of the one hundred and more medical schools in the United States, but even from these it can be seen that one can get a diploma of doctor of medicine in much less time, and at much less expense, from some schools than from others,—and we all know that the diplomas of these different schools are guarantees of very different education and qualifications.

There are also several different ideals as to what is desirable in medical education. For instance, there is the ideal of the literary man, of the clergyman, of the laborer, and of other classes of the general public. There is the ideal of the man who wants to obtain a medical degree as soon and as cheaply as possible, in order that he may commence practice; the ideal of the same man after he has obtained such a degree and has been for two or three years trying to get practice; and the ideal of the middle-aged successful practitioner who has learned several things by experience since he graduated. Then we have the ideal of the army and navy examining boards, the ideal of the man of means who wants to become a specialist without ever going into general practice, and the ideal of the man who wishes to be an investigator and a teacher, either from the love of science or from the desire for fame. Let us consider these ideals briefly. The chief demand of the great mass of the non-professional public is for general practitioners, and the qualifications which these should possess may be summed up in the statement that they should be competent to recognize the forms of disease and injury which are common in the community in which they practice, and should know, and be able to apply, the remedies which are most frequently used and found efficacious in such cases. They are expected, for the most part, to follow and not to lead. It is not necessary that they should be skilled in the refinements of modern pathology, or be thoroughly trained in minute anatomy or experimental physiology, or be great surgeons, or be well up in all the specialties. Observe that I say it is not *necessary*; it may be desirable, but in the majority of cases it is not practicable.

In their brief journey of life through this world the great majority of people must travel on the routes and by the vehicles provided for them by others, and, fortunately, they are usually content to do so. They move in groups which are "personally conducted," see the things they are told to see, try with more or less success to admire the things which they are told to admire; and their chief discontent occurs when their conductors are either silent or give contradictory

¹ Address delivered before the Medical Faculty of Yale College, June 23, 1891, by John S. Billings, M.D. (Boston Medical and Surgical Journal.)

orders, — when it comes to the parting of the ways. Most travellers on an Atlantic steamer accept without murmuring the edict that “passengers are not allowed on the bridge.”

The information which those who propose to earn their living by the general practice of medicine stand most in need of is that which will enable them to recognize the ordinary emergencies and to deal with them in the ordinary way. As students, their time, money, and zeal for study and investigation, are all usually more or less limited, and there are many things in a course which is called the “higher medical education” which are of comparatively little use to them. The clinical instruction which they can get at a school in the region of country in which they intend to practise will often be more valuable to them than that which they could get at a distant school of greater repute, simply from the difference in the class of cases presenting themselves for treatment. Good local pilots are in demand, although we have a superintendent of the coast survey. In some respects the old-fashioned system of medical apprenticeships, in which the student spent from one to three years in the office of a physician in general practice before he went to a medical school to hear lectures, was a good one for producing these general practitioners.

To learn to do such work easily and properly, one must live among the sick, learn how they look, how they talk, how they are to be talked to and handled; and must do this at close quarters, and not by looking on from the top bench of an amphitheatre, or from the outer ring of a group of thirty or forty men standing around a bed. Moreover, it is the common every-day ailments and their effects and treatment that the student wants to become familiar with at first, rather than the rare cases. Cases of colic, of effects of over-eating or drinking, of sore throats, croup or diphtheria, or scarlet-fever or mumps, of the ordinary fevers, of simple fractures and dislocations, of bad cuts of the palm of the hand, are far more important to him from a business point of view than brain tumors or ligations of the innominate artery.

And these comparatively simple, every-day cases are just what the young man reading in the office of his preceptor may become familiar with. How many of the men without such experience, who graduate this year at our great medical schools, have ever seen closely a case of measles, or scarlet-fever, or incipient small-pox; or have actually looked into the throat of a child suffering from diphtheria, or have ever assisted in adjusting and dressing a fractured thigh-bone, or in getting the clothing off from a case of extensive burn or scald? I have no doubt most of them could repeat the description of these things which they have heard or read, but they are not as well prepared to deal with such cases in that unhesitating way which commands confidence, as is the man who has seen and touched one or two such cases in his preceptor's office, and has observed what that preceptor said and did.

On the other hand, the number of practising physicians who are qualified to act as preceptors, and who are willing to give the requisite time and attention to students, is very limited; and with any other kind of preceptor the student wastes much time, is apt to lose interest, and become idle and unfit for continuous mental interest. If the student spent his apprentice year or two years in a preceptor's office, either at the end of his first or second year's medical lectures, or after obtaining his degree, it would be much better for him; but the latter course is open to the objection that he would probably think that he knew more than his pre-

ceptor. The Scotch medical schools prefer that the year spent as an articled pupil shall come after the first two years of education in a medical school. The decision of the British Medical Council has been that a five years' course of study shall be compulsory, and that the last year shall be spent in practical work.

Theoretically there is still a considerable amount of preliminary reading with a preceptor done in this country, but practically this method of beginning the study of medicine is fast disappearing. Through the kindness of the officers of some of our large medical schools I have obtained some data on this point, from which I infer that in the Eastern schools the proportion of students who claim to have read with a preceptor for one year before commencing lectures is from 1.5 to 30 per cent, and in Western and Southern schools from 25 to 60 per cent; but no doubt such reading in the majority of cases was merely nominal, and the student had seen little or nothing of practice. In most schools the certificate of the preceptor is not required.

The ideal of the average student who is in a hurry to begin practice needs no special description. What he wants is to pass the examinations with the least possible labor, — the less he is compelled to take for his money the better he is pleased. The ideal of the majority of the medical profession as to what should be the minimum course of study for the degree of doctor of medicine appears to be that the student should first obtain at least such preliminary education as is furnished by our ordinary high schools, and then should study medicine four years, the first of which may be with a preceptor, and three of which are to be occupied in attending a graded course of lectures, the last two years being largely devoted to clinical and hospital instruction. About one-third of our medical schools have expressed their intention of carrying out this programme. As regards the time, it is not sufficient, according to European standards, but it is perhaps the best general standard which can be fixed at present for the education of the general practitioner for this country. Its success depends upon whether the student has had the needed preliminary education. It is the want of this last which is the chief deficiency.

The ideal of the army and navy examining boards is that a surgeon in the government service should have received either the literary, classical, and mathematical training of the ordinary college course for the degree of bachelor of arts, or the training leading to a degree in scientific studies; and that, after that, he should have spent five years in medical studies, the last year as resident in a hospital.

This ideal cannot yet be enforced in either service, for the reason that they could not get enough men who come up to this standard to fill the vacancies, so that the actual standard is somewhat lower than this, although it is higher than the minimum standard of any medical school or of any State board of examiners. Through the courtesy of the surgeon-generals of the army and navy, I am able to give you the following results of the work of their examining boards for the last ten years:—

Before the army boards, 348 candidates presented themselves during this period, of whom 76, or 22.3 per cent, were approved and passed; 31 were rejected for physical disqualifications; 90 failed to pass the preliminary examination; and the remainder failed to pass the medical examination. The rejections for physical defects are for the last three years only.

Before the navy boards, 237 candidates presented themselves, of whom 55, or 23.1 per cent, were approved and passed

75 were rejected for physical disqualifications; and the remainder either withdrew or failed to pass.

Evidently the standards of the two boards are about the same. The proportion of those rejected for physical defects is noteworthy. In a general way we may say that about one-fourth of the candidates before such boards are approved, and one-fourth fail on the preliminary examination as to general education. Putting aside those rejected for physical causes, and making the necessary corrections for a certain number who came before the boards more than once, we find that of 429 examined, 129, or 30.2 per cent, were successful.

Of those candidates who had a college degree, 34 per cent succeeded, and of those who had no such degree, 28.9 succeeded. Of those candidates who had had one year's residence in hospital, 40 per cent passed, while of those who had not been residents, only 21 per cent were successful. The percentage of successful candidates from different schools varies greatly, ranging from 9 to 56 per cent, for those schools from which more than ten candidates presented themselves. I cannot go into details on this point, but may say that taking the medical schools of Harvard, Yale, the College of Physicians and Bellevue Hospital of New York, the University of Pennsylvania, and the University of Virginia together, of 141 candidates, 65, or 46.1 per cent, succeeded; while for all the rest of the schools in a body, of 586 candidates, 64, or 22.3 per cent, succeeded.

The figures from Yale alone are too small to draw accurate conclusions from, but in strict confidence I will tell you that of the five graduates of the Yale Medical School, who came before the army and navy boards during the last ten years, three, or 60 per cent, have passed. The greatest percentage of successful candidates comes from those who were between 24 and 25 years of age when they graduated, being 31.7 per cent, as against 27.9 per cent for those who were under 22, and 26.2 per cent for those who were over 25 on graduation.

Admitting it to be a fact that different schools have different minimum standards for graduating doctors of medicine, to what extent are these differences necessary or desirable? There is at present a very general demand that those schools which have the lower standards shall raise them to the ideal of the medical profession just stated. It seems as if the supply of physicians is now, in most parts of the country, in excess of the demand, the number of medical men being from two to three times as great amongst us, in proportion to the population, as it is in France or Germany, while the annual number of graduates also greatly exceeds the number of places to be filled.

Under these circumstances, there is necessarily a struggle for existence, in which the men of inferior qualifications usually, though not always, fail. The schools, however, will not shape their course so much with reference to the real or supposed interests of the profession or of the public, as with reference to the demands of their immediate customers, the students, and many of these, as has been said, do not want any more education than is absolutely necessary to enable them to begin practice. The ability and inclination to pay for professional services differs greatly in different localities and among different classes of people. Attempts to enforce a minimum standard of qualifications, by prescribing a minimum time for the course, and a minimum for the number of lectures in certain specified branches, will not result in fixing a uniform minimum standard of results obtained, for this can only be assured and maintained by some system of in-

spection and testing of results which is independent of the schools or, at all events, of each individual school. When, as Professor Sumner says, "A and B put their heads together to see what C ought to be made to do for D," there is small prospect of result so long as C is free to do as he likes.

In the Russian myth, when the raven brought the water of life and the water of death to the gray wolf, the first thing that the wolf did was to test their powers on the raven himself, to determine whether his task was properly done. The public do not have an opportunity of seeing the effect of such a test as this upon those who come to them from the schools professing to have obtained the knowledge of healing: if they had, the complaints of overcrowding in the profession would probably cease.

From the commercial point of view it seems plain that there are too many medical schools in this country, that the education which many of them are giving is a very poor one, and that the students who are attracted to these last by offers of a cheap and short course waste their time and their money.

The only really efficient remedy for this state of affairs is a system of State examinations, with minimum standards. This also has its evils, since it must lead to cramming; but it is the best we can do at present. It is urged by some that this minimum standard should be uniform throughout the United States, but in that case, it would be unnecessarily low in some parts of the country. The precise nature of the requirements in different regions depends on the density of population, and on the ability of the great mass of the people to pay enough to induce highly educated physicians to settle among them. It would be better if it were otherwise, and if every one could have the benefit of the best professional skill; but matters are adjusted in this world largely by conflict of interests. Certainly no one who intends to practise medicine should be content with the least amount of knowledge which will enable him to pass the required examinations, whatever the standard of those examinations may be.

Putting aside now this matter of a minimum standard, let us consider briefly an ideal of a medical education of a higher type. In addition to the incipient family practitioner of ordinary qualifications, the beginners in the profession, there is need of, and employment for, highly skilled, thoroughly trained physicians and surgeons as family physicians, as consultants, as specialists, and as investigators and teachers.

There are two ways in which these needed men may be educated and developed. The first is by their commencing with the ordinary course of instruction for general practice in the manner just spoken of, and then going on, after graduation and commencing practice, to study and perfect themselves in details, according to individual tastes and opportunities; and this has been the course pursued by a large number of our most distinguished American consultants and specialists. The other is to lay a broad and sound foundation of preliminary education before giving any attention to clinical study or practice. This means an education at least equivalent to that required of candidates for the degree of bachelor of arts from our leading universities, including Latin, French, and German, and mathematics to include trigonometry, and the elements of analytics. It should also include one year's work in a physical laboratory, two years' work in chemistry, two years' work in biology, at least one year's work in practical anatomy, and one year's course in materia medica.

In other words, it requires that the youth of sixteen, having obtained a good high-school education, shall go on to spend

at least five years in additional study before he commences to see any thing of practice. He should then spend at least three years more in special medical and clinical studies, during one year of which he should, if possible, reside in a hospital. If then his purpose is to become a specialist, an original investigator, and a teacher, it is desirable that he should spend two years more in clinics and laboratories devoted to his special subject, and at least half of this time should, at present, be spent abroad. These are the broad outlines of what I suppose most physicians of the present day would consider a desirable scheme of medical education for an intelligent boy with a fair amount of liking for study, good health, and sufficient means to enable him to go through with it without making undue demands upon his parents or guardians.

You will observe that there are several qualifying clauses in that last sentence. The aphorism that it does not pay to give a five-thousand-dollar education to a five-dollar boy must be constantly borne in mind in considering these questions. On the other hand, it is also to be noted that in the preparation of educational schemes it is not necessary to provide for the demands of youths of extraordinary ability and industry — for men of genius. Beds suitable for giants are not required as part of the stock of an ordinary furniture store, especially if it require giants to make them. Some cases of disease will recover without treatment, though the cure may be hastened by proper management; some will die under any treatment; the result of some depends on the treatment. It is much the same in education. Some will acquire knowledge and power without special training; others will never acquire these things under any training; but the career of many depends, to a large extent, on the training which they receive. The recent announcement of a compulsory four years' course of medical studies by Harvard and the University of Pennsylvania, soon to be followed by a similar announcement from Columbia, looks toward the ideal just indicated.

The number of those who are obtaining a college education as a preparation for medical study has increased, and will still more increase as the competition among an excessive number of physicians becomes fiercer.

From information received from some of our leading medical schools for the present year, it appears that the proportion of students who have taken preliminary degrees before commencing the study of medicine varies from fourteen to forty-three per cent in Eastern schools, from three to twelve per cent in Western schools, and from fifteen to twenty per cent in Southern schools.

Just here comes in a very difficult point. When shall general education cease and special training begin? The answer to this must depend largely on the individual, but it seems to me that the present tendency is to begin to specialize too soon. This early specialization of study and work may lead to more prompt pecuniary success, but not, I think, to so much ultimate happiness and usefulness as the longer continuance of study on broader lines. "For it is in knowledge as it is in plants," as Bacon says. "If you mean to use the plant, it is no matter for the roots; but if you mean to remove it to grow, then it is more assured to rest upon roots than slips. So the delivery of knowledge as it is now used, is of fair bodies of trees without the roots — good for the carpenter but not for the planter. But if you will have science grow, it is less matter for the shaft or body of the tree, so you look well to the taking up of the roots."

In discussions on medical education and the duties of

medical schools, we are too apt to lose sight of the fact that the best that the student can do in them is to begin to learn. If he does not study much longer and harder after he graduates than he does before, he will not become a successful physician. Moreover, the great majority of men have different capacities for learning certain things at different ages. They lose receptive power as they grow older.

Permit me to use here a personal illustration, and pardon the apparent egotism of an old gentleman who refers to his youthful days. Thirty-three years ago I began the study of medicine, having obtained the degree of bachelor of arts after the usual classical course of those days. It so happens that the smattering of Latin and Greek which I obtained has been of great use to me, and I may, therefore, be a prejudiced witness; but my acquaintance with many physicians at home and abroad has led me to believe that the ordinary college course in languages, mathematics, and literature is a very good foundation for the study of medicine, and I do not sympathize with those who demand that all who are to enter on this study shall substitute scientific studies for all the Greek and a part of the Latin of the usual course. This change is good for some but not for all. I had attended lectures in physics and chemistry, but had done no laboratory work, and I could read easy French and German. Thus equipped I began to read anatomy, physiology, and the principles of medicine. Nominally I had a preceptor, but I do not think I saw him six times during the year which followed, for I was teaching school in another State. Nevertheless, he told me what books to read, and I read them. The next thing was to attend the prescribed two courses of lectures in a medical college in Cincinnati. Each course lasted about five months, and was precisely the same. There was no laboratory course, and I began to attend clinical lectures the first day of the first course. One result of this was that I had to learn chemical manipulation, the practical use of the microscope, etc., at a later period when it was much more difficult. In fact, I may say that I have been studying ever since to repair the deficiencies in my medical training, and have never been able to catch up.

Probably a large number of physicians over fifty years of age have had much the same experience, and feel that there are certain things, such as the relations of trimethyloxyethylene-ammonium hydroxide in the body, or the causation of muscular contraction by migration of labile material between the inotagmata, — the bearings and beauty of which might as well be left to younger men. Not that these things are specially difficult to understand, but they form part of a new nomenclature which in most cases it is not worth the while of the older men to learn, because it is far more difficult for them to master it than it is for their sons. One of the most comfortable and satisfactory periods of a man's life is that when he first distinctly and clearly recognizes that in certain matters he is a helpless old foggy, and that he is not expected to know anything about them.

(To be continued.)

EXPERIMENTAL POTATO FARMING.

THE question of the influence of different qualities of seed upon the earliness and productiveness of a given variety of potatoes is one that has been much discussed, and the following experimental planting was made at the Ohio Agricultural Experiment Station to test the value of three qualities of seed. The seed of lot I. was grown from a planting made in the middle of March, and harvested and stored in the cellar as they ripened. The potatoes had sprouted badly during the winter, and were a good deal

shrivelled. Lot II. was from the main planting, made in the latter part of April, and dug and stored in September. The tubers were quite firm, and had sprouted but moderately. Lot III. was seed from a second crop grown in 1889 in the following way. A few hills each of several sorts, from the plat which produced the seed of lot I., were dug July 11, and the potatoes planted the same day on ground that had been cleared of early peas. These gave a light yield of tubers of even size and of very fine quality. When taken from the cellar for planting they were as firm and free from sprouts as when stored.

Three pounds of each of the above lots were cut to three-eye pieces, and planted March 18. With one exception, the sorts in lot III. were from five to eight days later than the others in coming up, while between lots I. and II. no difference could be noted.

The vines of lot III., when they came, were much stronger than the others, and in a few weeks overtook and outgrew the other lots, making a much more vigorous and heavy stand.

The date of blooming, though not varying uniformly on the whole, favors the vigorous plants of lot III. for earliness, and shows that the comparatively weak and slender plants of lot I. bloomed later, or in three cases failed to perfect any bloom.

The date at which they afforded potatoes of table quality did not vary appreciably in favor of either, but the product, both in quantity and quality, was largely in favor of lot III.

While the product of lot II. was not, in all cases, much ahead of lot I. in weight, the percentage of marketable tubers was greater, and these were of greater average size.

Summarizing the results of this trial, it seems, first, that nothing is gained in earliness by the use of second-crop seed; second, that there is a positive gain in amount of product, as well as size of tubers, over that of first-crop seed grown in the same locality; third, that firm, well-kept, unsprouted seed is better than that which is sprouted and shrivelled, giving a heavier product and of better size and quality. These inferences may not be conclusive, but seem to be fairly deducible from the above results.

Still further to test the practicability of growing the second crop of potatoes in one season, five pounds of seed of each variety in lot III., as above mentioned, were dug July 23, and planted the same day, cut in halves. These came up rather unevenly, the same fault having been noticed in the previous trial. The product was of unusually fine quality, and the yield a very good one, when it is considered that potatoes of ordinary planting were almost a failure in that section of the country.

ENTOMOLOGICAL OBSERVATIONS AND EXPERIMENTS.

THE reports of the six permanent field agents of the Division of Entomology of the Department of Agriculture are included in a bulletin just issued from the government printing office at Washington. These reports are printed in full, though they are little more than summaries of the work in general performed by each agent. Special reports upon specific subjects have from time to time been sent in by special direction, and those have been published in *Insect Life*.

Mr. Lawrence Bruner, who last year reported upon the insects injurious to young trees on tree claims, has the present season devoted much of his attention to insects affecting, or liable to affect, the sugar-beet, a crop of growing importance in Nebraska, the State in which he is located. Although but one season's collecting has been done, some sixty-four species have been observed to prey upon this crop. As is shown by the report, nearly all of these can be readily kept in subjection by the use of the kerosene emulsion or the arsenites.

Mr. D. W. Coquillet's report, from California, is mainly devoted to methods and apparatus for the destruction of scale-insects by means of fumigation. The experiments were aimed at the red scale, which is one of the most difficult to treat with washes. He describes the simplified tents and the rigging which enables them to be used rapidly, and shows the advantage of excluding the actinic rays of the light. Judging from recent California newspapers, the use of this method of fighting scale-insects is rapidly increasing, and the comparatively expensive apparatus is already owned by a large number of fruit-growers. This improved method

is the legitimate outgrowth of experiments which were instituted by the department at Los Angeles in 1887, and possesses the advantage over spraying that it can hardly be done in a slovenly manner. If used at all, its effects are nearly complete.

Mr. Albert Koebele, while reporting upon a number of interesting fruit pests, notably the tent caterpillars of the Pacific slope, and a noctuid larva which destroys the buds of certain fruit trees, devotes most of his report to the description of certain tests, which Professor Riley, the government entomologist, directed him to make with different resin compounds against the grape phylloxera in the Sonoma Valley during September and October of the past year. The results have been fully as satisfactory as were anticipated, and the economy of the process is very striking, labor being practically the only expense.

Miss Mary E. Murtfeldt reports upon the insects of the season in eastern Missouri, and also gives the results of experiments which she has made with certain insecticides submitted to her from the office of Professor Riley for trial. She also presents descriptions of four *Microlepidoptera*, which are new in the rôle of feeders upon the apple.

Professor Herbert Osborn reports upon the insects injurious to forage-crops, meadows, and pastures in Iowa. His report last year was mainly taken up with the consideration of the leaf-hoppers, to which he gives some further consideration this year, adding some notes on locusts and crickets. He presents also a series of miscellaneous observations.

Mr. F. M. Webster of Indiana devotes his report mainly to the Hessian fly, discussing the number and development of broods, the effect of the larvæ upon plants, the effect of the weather on the development of the fall brood, and preventive measures. He also gives some notes upon three of the species of plant-lice found commonly upon wheat.

NOTES AND NEWS.

THE Rev. J. Hoskyns-Abrahall writes to *Nature* that on June 10, about 10.30 P.M., near Woodstock (England), he saw what he describes as "a beautiful phenomenon." "Suddenly," he says, "at the zenith, east of the Great Bear, shone forth a yellow globe, like Venus at her brightest. Dropping somewhat slowly, it fell obliquely southward. As it passed in its brilliant career, it lighted up its dusky path with a glorious lustre. When it had descended about half-way down toward the horizon, it burst into a sparkling host of glowing fragments, each dazzlingly shot over with all the hues of the rainbow."

— According to *Industries*, two novel modifications of sulphur have been recently discovered by Engel. The first, like that proved to exist in Wackenröder's solution, is soluble in water and very unstable. The other is crystalline, soluble in carbon disulphide and chloroform, and polymerizes slowly in the cold, and quickly at a temperature of 100° C., but, unlike prismatic sulphur, which changes on keeping into the octahedral variety, it becomes converted into the white insoluble form which commonly constitutes so large a percentage of the material known as "flowers of sulphur."

— In a new process for the manufacture of phosphorus by electricity used by the Phosphorus Company, at Wednesfield, near Wolverhampton, England, says the London *Engineer*, the raw material and coke are all fed into a specially designed furnace, reduced to vapor by electric heat, and the vapor condensed into marketable phosphorus, the elaborate chemical material hitherto needed in dealing with the raw materials before putting them into the furnace thus being dispensed with. The estimated consumption of phosphorus throughout the world is only two thousand tons per year, used chiefly for match-making. Extensions are contemplated at Wednesfield, which will ultimately, it is anticipated, lead to the company being able to make half this quantity, at that place.

— W. J. Lincoln Adams, editor of the amateur photography department of *Outing*, says in the July number: "The preparations for the twelfth annual convention of the Photographers' Association of America, which will be held this year in Buffalo from July 14 to 17, are actively progressing, and the indications

point to a large attendance. Amateurs as well as professionals are admitted both as exhibitors in the various competitions and as members, with all the privileges of the association. Application for full particulars should be made to Mr. W. A. Davis, secretary, 872 Broadway, New York."

— It seems extraordinary, says the *Illustrated American*, to observe a number of bats in the evening flying back and forth through the trees with remarkable rapidity, but without ever coming in contact with the branches or hurting themselves. Spallanzani, the Italian naturalist, placed a bat in a dark inclosure, across which were stretched a number of threads, crossing and recrossing each other. The bat flew rapidly back and forth, trying to effect its escape, but avoided the threads with as much ease as if they had not been in its way in the least. Whether this curious power was the result of a sixth and unknown sense was long a puzzle to naturalists. To decide this knotty point, Spallanzani resorted to the cruel expedient of blinding a bat, and found that it still flew among the threads without being, to all appearances, any more inconvenienced than if it still had its eyesight.

— Dr. Mueller, of Yackandandah, Victoria, has written a letter to the *Pharmaceutical Journal* in which he states that in cases of snake bite he is using a solution of nitrate of strychnine in 240 parts of water mixed with a little glycerine. Twenty minims of this solution are injected in the usual manner of a hypodermic injection, and the frequency of repetition depends upon the symptoms being more or less threatening, say from ten to twenty minutes. When all symptoms have disappeared, the first independent action of the strychnine is shown by slight muscular spasms, and then the injections must be discontinued unless after a time the snake poison re-asserts itself. The quantity of strychnine required in some cases has amounted to a grain or more within a few hours. Both poisons are thoroughly antagonistic, and no hesitation need be felt in pushing the use of the drug to quantities that would be fatal in the absence of snake poison. Out of about one hundred cases treated by this method, some of them at the point of death, there has been but one failure, and that arose from the injections being discontinued after a grain and a quarter of strychnine had been injected. Any part of the body will do for the injections, but Dr. Mueller is in the habit of making them in the neighborhood of the bitten part or directly upon it.

— At a recent meeting of the Royal Statistical Society, London, a paper was read by Mr. Noel A. Humphreys, secretary of the census office, on the results of the recent census and estimates of population in the largest English towns. The first part of the paper — of which a summary is given in *Nature* of June 18 — was devoted to the consideration of the recently issued results of the census in April last in the twenty-eight large English towns dealt with in the Registrar General's weekly returns. It was pointed out that, although the increase of population within the boundaries of these towns showed an increase of nearly a million in the last ten years, the increase was less, by considerably more than half a million (605,318), than would have been the case if the rate of increase had been the same as in the preceding ten years, 1871-81; and that the rate of movement of population showed striking variations in the different towns. The rate of increase in these twenty-eight towns, it was stated, has pretty constantly declined in recent years, and has fallen with scarcely a break during the last five intercensal periods from 24.3 per cent in 1841-51 to 11 per cent in 1881-91. The percentage of increase within the boundaries of registration in London (practically those of the county of London) declined in the same period from 21.2 to 10.4. The rate of actual decline of population in central London continues to increase, and the rate of increase of the other parts of the metropolis, including even the aggregate outer ring of suburban districts, continues to decline. Examined in detail, the provincial towns show, with few exceptions, the operation of similar laws,—actual decrease in the central portions, and marked decline in the rate of increase in the other portions, the latter being specially noticeable in those towns with comparatively restricted areas. This examination, while showing the marked general decline in the rates of increase in these towns, discloses striking variations in the rates of increase in successive census periods. Mr. Humphreys called

attention to the fact that these striking changes in the rates of movement of population in the large towns interpose the greatest difficulty in estimating, even approximately, their population in intercensal periods. The estimate of population in Liverpool, based upon the rate of increase between 1871 and 1881, exceeded the recently enumerated number by more than 100,000, or by 20 per cent; while in Salford the percentage of overestimate, by the same method, was 26 per cent. Thus the recent birth-rates and death-rates in these two towns have been underestimated by no less than a fifth and a fourth, respectively. The various methods that have been at different times suggested for estimating the population of towns in intercensal years, in substitution of Dr. Farr's method, still used by the Registrar-General's department, were severally considered, and it was shown that no hypothetical method yet devised affords reasonable promise of satisfactory results. It was therefore urged that a quinquennial census could alone supply a remedy for the present difficulty, which threatens to impair the public faith in death-rates, the failure of which would most seriously hinder and imperil the health progress of the country.

— Mail advices from Australia state that an exploring expedition, under the auspices of the Geographical Society of Australia, and equipped through the liberality of Sir Thomas Elder, was ready to start from Adelaide in April. The intention is to explore some of the still unknown portions of Australia. The leader of the expedition is Mr. David Lindsay, the Australian traveller, who is well qualified for the post. The second in command is Mr. F. W. Leech of Adelaide. The other members are Mr. L. A. Wells, surveyor; Dr. F. J. Elliott, medical officer and photographer; Mr. V. Streich, geologist; and Mr. R. Helms, natural history collector; besides four other gentlemen as assistants. Forty-four camels with four Afghan drivers, and a native guide, form part of the expedition.

— At a meeting of the Royal Meteorological Society, London, on June 17, Mr. A. J. Hands gave an account of a curious case of damage by lightning to a church at Needwood, Staffordshire, on April 5, 1891. The church was provided with a lightning conductor, but Mr. Hands thinks that when the lightning struck the conductor a spark passed from it to some metal which was close to it, and so caused damage to the building. Mr. W. Ellis read a paper on the mean temperature of the air at the Royal Observatory, Greenwich, as deduced from the photographic records for the forty years from 1849 to 1888, and also gave some account of the way in which, at different times, Greenwich mean temperatures have been formed. Mr. Ellis also read a paper on the comparison of thermometrical observations made in a Stevenson screen with corresponding observations made on the revolving stand at the Royal Observatory, Greenwich. From this it appears that the maximum temperature in the Stevenson screen is lower than that of the revolving stand, especially in summer, and the minimum temperature higher; while the readings of the dry and wet bulb thermometers on both the screen and the stand, as taken at stated hours, agree very closely. Mr. W. F. Stanley exhibited and described his "phonometer," which is really a new form of chronograph designed for the purpose of ascertaining the distance of a gun from observations of the flash and report of its discharge, by the difference of time that light and sound take in reaching the observer. The instrument can also be used for measuring the distance of lightning by timing the interval between the flash and the report of the thunder. A paper was also read by Mr. A. B. MacDowell, on some suggestions bearing on weather prediction.

— The agricultural experiment station at Cornell University has made a series of investigations on the loss in stable manures by exposure in open barnyards, the results of which are summarized in Bulletin No. 27 of that station. Horse manure was saved from day to day until a pile of two tons had been accumulated. Cut wheat straw was used plentifully as bedding, the relative amount of straw and manure being 3,319 pounds of excrement and 681 pounds of straw. Chemical analysis showed that one ton of this fresh manure contained nearly ten pounds of nitrogen, seven and one-half pounds of phosphoric acid, and eighteen pounds of potash, making its value \$2.80, if these constituents be valued at the

same rate as in commercial fertilizers. The pile of manure thus made was put in a place exposed to the weather, and where the drainage was so good that all the water not absorbed by the manure ran through and off at once. It remained exposed from April 25 to Sept. 22, 1890, at which time it was carefully scraped up, weighed, and a sample taken for analysis. It was found that the 4,000 pounds had shrunk to 1,730 pounds during the five months, and analysis showed that this 1,730 was less valuable, pound for pound, than the original lot of manure. It had not only lost by leaching, but by heating or "fire fanging" during periods of dry weather, and the value of the pile of 4,000 pounds had shrunk from \$5.60 to \$2.12, a loss of 62 per cent. In summing up the results of this experiment, Director Roberts says: "It seems safe to say that under the ordinary conditions of piling and exposure, the loss of fertilizing materials during the course of the summer is not likely to be much below fifty per cent of the original value of the manure." Further experiments showed that the liquid manure from a cow is worth as much per day as the solid manure, and that the combined value of the two is nearly ten cents per day, if valued at the same rate as commercial fertilizers; that from a horse is valued at seven cents per day, that from a sheep at one and one-half cents, and that from a hog at one-half cent. Director Roberts is careful to explain that these values will have to be modified to suit individual circumstances. What he means is, that, if farmers can afford to buy commercial fertilizers at current prices, then the manures of the farm are worth the prices given. The bulletin closes with plans illustrating a cheap manure shed, under which manure may be saved with practically no loss.

— Considerable progress is being made by the government of Japan in its survey operations, as we learn from the *Proceedings of the Royal Geographical Society* for June. A map on the scale of 1:200,000 was commenced sixteen years ago, and is now published (in seventy-seven sheets) for the whole of the islands except Yezo. This is, however, considered merely as a provisional publication, being based on Japanese methods of work, and therefore not to be relied on for accuracy. A modern survey was commenced eleven years ago, with triangulation of four orders, and depending on some five base-lines. Copper-plate, photogravure, and lithography are employed in the reproduction of these maps, and few if any Europeans are employed. The work appears to be excellent. Only a small proportion is completed, and it will be many years before the whole is finished. About three hundred of the published sheets can now be bought: the scale is 1:20,000. A map on a scale of 1:100,000 is also being prepared, based on the 1:20,000 map, but no sheets are yet for sale. The names on these maps are in Japanese characters. In the Geological Survey of Japan reconnaissance map, Roman characters are used, and 1:400,000 is the scale.

— At a meeting of the Geographical Society of Paris, on March 20, the Minister of Public Instruction communicated a report by MM. Rousson and Willems upon their scientific mission to Tierra del Fuego, a condensed translation of which appears in the *Proceedings of the Royal Geographical Society* for June. The region explored by them is comprised within 52° 30' and 53° 30' south latitude, and 68° 15' and 70° 30' west longitude. This part of the country is traversed by a chain of mountains running from Cape Bogueron, where it rises abruptly to over 1,650 feet, to Cape Espiritu-Santo. Great lagoons, forming small rivers, extend into the immense plains. The watercourses are very numerous, but many of them are dried up in summer. The Rio del Oro, which is the most important stream of the northern part of the island, empties itself into the Bay of Felipe. The climate is very variable, according to the locality. The travellers did not suffer from cold at all during their journeys, but two men were frozen to death at Porvenir. The climate, however, is not so rigorous as supposed. The lowest temperature recorded by the travellers was 43° F., and the maximum 69°, the nights being always very cold. Winds are very frequent, the most violent being those from the west, which attain a velocity of seventy miles an hour. During the three most rigorous months of the year, only six days of rain and two of snow were registered, but on the higher hills much more

snow fell. The winter was stated by the natives to have been exceptionally mild. The Indians inhabiting the north of the island are the Onas. They are very tall, and sometimes attain over six and a half feet in height. Their skin is copper-colored and oily; their face is oval, forehead narrow, and their long hair falls down over their shoulders. Their eyes are small, and eyebrows well defined; nose slightly aquiline, cheek-bones prominent, mouth very large, with small yellowish teeth. They are very muscular and strong, and are great warriors, being continually in conflict with the Indians of the west and south. It is an error to suppose that they are cannibals, or that they burn their corpses. Several places were found where the Indians had buried their dead. They believe in a spirit whom they call "Waliche," and to whom they refer all good and evil. The north of Tierra del Fuego is completely destitute of trees. The only shrubs found there are the calafate, the romorille, and the mata-nigra. Quadrupeds are few, but birds of all kinds plentiful. Magnetic iron can be obtained in all parts in great quantity, and gold is also found at some points, but often at very great depths. The native population of the north may be estimated at not more than three hundred. The whole mainland north of the Straits of Magellan, which ten or twelve years ago was unoccupied, has in recent years become covered with small farms, where sheep and horned cattle are reared, and these farms have prospered to such an extent that the vast region they occupy is even now too small. The cordillera of the Andes bars any extension towards Chili, so that it may be concluded that the archipelago of Tierra del Fuego will, in the near future, receive the overflow of Patagonia. There is already on the island a model farm where nearly twenty thousand sheep and over sixty thousand horned cattle are reared.

— "I have never expressed any opinion to my professional brethren on the fundamental value of Koch's method, simply because I do not know how such an opinion can be formulated," said Professor Virchow recently in the Prussian House of Deputies, during a debate on granting additional funds for the Koch Institute. "I have only communicated a series of personal observations," he continued, "which have indeed been of service in directing attention to one part of the question, and have especially enforced the need for calm and objective study that is so requisite in these difficult subjects. Dr. Graf [a previous speaker] is still steeped in optimism. He has no right to speak of the importance of the matter until he has proved it, and it is, in fact, not proved. But it would be just as foolish if we, as pessimists, were to say, 'The matter is of no importance whatever; it is only a poison, a noxious substance.' The question has, in fact, been developed in unexpected directions, leading in many quarters to the hope that very striking results can be produced by these powerful measures — a hope we cannot yet say has been annihilated. As a matter of fact, there is not a single case known in which any form of tuberculosis has been cured by this means. All cases which were for a while regarded as cured have afterward been found to relapse. The improvements were merely temporary, such as often occur under other treatment. On the other hand, there is no doubt whatever that many serious dangers have been revealed, with regard to which I may claim some merit for myself. Nevertheless, from what I have just said, no doctor who feels called upon to make further trial of the remedy could by any possibility lay himself open to prosecution. The original trials were, in point of fact, made after results had been obtained in animals which seemed to justify the expectations that were raised regarding the discovery."

— Theo. B. Comstock, late of the Geological Survey of Texas, is now director of the University of Arizona, at Tucson.

— Professor A. T. Wood, formerly of the University of Illinois, has accepted a position as professor of mechanical engineering in the Washington University, St. Louis, Mo.

— Dr. John I. Northrop of Columbia College has died as the result of burns received June 25. Dr. Northrop, with two assistants, had gone down in the cellar of one of the buildings to supervise the placing of some newly acquired specimens in alcohol, when an explosion occurred and all three were severely burned. Dr. Northrop was about thirty years old and was highly esteemed.

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THE MOA IN AUSTRALIA.¹

RECENT discovery in Lord Howe's Island has proved that post-tertiary Australia extended far to the east of its present shores. Still it remains true that if among the results of inquiry into the past phases of Australian life there be one suggestive of the possible inter-relation of faunas apparently as distinct in history as in location, it is the discovery of a bird identical with the moas of New Zealand, and of others so near akin to them as to have been pardonably mistaken for them by acute observers. Fossils so like moa bones as the latter must necessarily have been, clearly show that the evolution of these grand birds was not initiated in their recent island home, but that it had already made considerable progress in that portion of a far-reaching continent which we now name Australia, when a period was put to the Nototherian age by desolating outflows of lava over the greater part of the land. Having regard to the improbability of birds so organized effecting a passage over sea under any ordinary circumstances, we can hardly escape the further conclusion that New Zealand's entire separation from the continental area was brought about in time not more remote than that era of intense volcanic activity. One is even tempted to surmise, and it appears very possible to do so without absurdity, that it was one among the consequences of that very manifestation of energy. But this is an instance of speaking without book on a question which should be rigorously, as it may be confidently, left for decision in the hands of New Zealand geologists. Cumulative evidence to the same effect, but still more explicit in kind, is yielded by a relic of a true dinornis. From it we gather that the process of evolution had, in the self-same place and time, accomplished more than we could have justly anticipated without such warrant—the production of that more complete departure from the rest of the *Struthionidæ* which we recognize in the moa type. And again, as the "wolves" and "devils" of Tasmania, the "crowned pigeons" of New Guinea, and the "wallabies" of those and other Pacific islands, have been cut off from the common ancestral seat of their genera, so also have the moas.

It is indeed somewhat strange that the notion of the same genus of birds existing at one time in Australia and at a later period in New Zealand should ever have been thought inadmissible, yet it is difficult to see what other conception of the case should have been in the mind of Sir Richard Owen when he spoke of the advent of an Australian moa as "an exceptional extension of a New Zealand genus to Australia." At the same time it is by no means to be regretted that Owen did take this view, and that in consequence he regarded with suspicion any Australian claim to moa rank, however well accredited. It is to the stimulation of his critical faculty by incredulity that we owe the full assurance that

there has existed a bird which, though not dinornis, had much in it pertaining to dinornis, a degree of affinity which under the circumstances could not have been overstated, but, as stated, is quite sufficient to show that Australia was the nursery of the sept.

But let us quit generalities for the more immediate object in hand, viz., a brief review of the recorded occurrences of the moa stock in Australian deposits. As if to excite a hope that such occurrences would be frequent, the first of all the extinct birds of Australia to be drawn from those deposits and made known to science was a struthious bird dwarfing in size not only existing cassowaries and emus, but the emu which was contemporary with it. A thigh-bone of this bird was discovered in the year 1836 by Sir Thomas Mitchell in a brecchia cave in Wellington Valley, New South Wales. It was examined by Sir Richard Owen, and figured by him in an appendix to Mitchell's "Three Expeditions into the Interior of Eastern Australia," 1838. At that time, as we are subsequently informed, Owen determined the bone "to belong to a large bird, probably from its size struthious or brevipennate, but not presenting in its femur characters which justified him in suggesting closer affinities." The study of moa bones in after years enable him, he says, to perceive that in some features of importance the cave femur "resembles that bone in the emu rather than in dinornis." We learn further that "the length of this fossil was 13 inches, the breadth of the middle of the shaft not quite 3 inches,"—measurements which are noteworthy, as they render it apparent that in its dilated proportions the bone was much more like the dinornis femur than that of the emu, which has a breadth of only 1½ inches to a length of 8¾ inches.

Thirty-three years elapsed before any further light was thrown upon a problem which was sufficiently obscure. It then issued from the Peak Downs, near the centre of Queensland, where in 1869 a well was being sunk. The workmen passed through thirty feet of the residuum of basaltic decomposition, the "black soil" characteristic of "downs" country, then through 150 feet of drift pebbles and boulders. Lying on one of the boulders, at 180 feet from the surface, they met with a short thick femur, which was happily preserved from the usual fate experienced by such finds, and, more happily, passed into the hands of the well-known geologist, the Rev. W. B. Clarke. In concert with Mr. G. Krefft, then curator of the Australian Museum, Mr. Clarke compared it with the moa bones, with the result that he felt himself justified in announcing the discovery in the *Geological Magazine* of that year in a letter entitled, "Dinornis an Australian Genus." At Sir R. Owen's solicitation a cast of this bone was sent to him by the trustees of the Australian Museum, and this, in 1872, formed the subject of a communication from Owen to the Geographical Society. After pointing out at length the characters in which this femur resembles dinornis and dromæus (emu) respectively, the examiner decides "that in its essential characters it resembles more that bone in the emu than in the moa, and that the characters in which it more resembles dinornis are concomitant with and related to the more general strength and robustness of the bone, from which we may infer that the species manifested dinornithic strength and proportions of the hind limbs combined with characters of closer affinity to the existing more slender limbed and swifter wingless bird peculiar to the Australian continent." To the bird represented by the fossil Owen gave the name "dromornis," a name significant of his conception of the paramount affinity displayed by its femur. If with that judgment a succeeding observer finds it impossible to completely harmonize his own conclusion, and says so, it is because in this case compulsion rides rough-shod over peril. That the dromornis bone has important features which relate it to the emu rather than to the moa is a position which is unassailable, but that these alone are its "essential" characters is a postulate, and one that has no right to command assent. Essential they are among the dromæan features of the bone; but of the compound dromornis bone as a whole they form but a part of the essentials. The absence of the air-duct communicating with the interior of the bone, a characteristic dinornithic feature, seems quite as important as a structural index to habit as the dromæan set of the head of the bone; and, being strictly dinornithic, it is not "related to the general strength

¹ By C. W. De Vis, M.A., in the New Zealand Journal of Science for May, 1891.

and robustness of the bone," but to its comparative solidity. Again, the "dinornithic strength and proportions of the hindlimbs" is a reminder which should carry more weight than it was probably intended to bear, but is nevertheless but a partial statement of the fact, for it leaves out of consideration the great difference in the relative proportions of the bone under examination. It is not that the bone is altogether larger or smaller in the same ratios of length and breadth, but in different ratios, the dromornis and dinornis ratio being much the same. The dromornis femur is but one-third longer than that of the emu, yet its shaft is twice as thick transversely, and its upper end is more than twice as broad. With such bones the bird would probably have the general appearance, the gait, and habits of a moa rather than those of an emu. In short, dromornis exhibits at the least an intermediate form between the moa and the emu, probably a nearer approximation to the former than to the latter.

After another interval of fifteen years a third dinornithic bone was picked up in King's Creek, on the Darling Downs, by Mr. Daniels, and by him presented, with other contemporaneous fossils, to the Queensland Museum. This again presents the upper end of a thigh-bone, but minus the upper part of the great trochanter, which appears to have been shorn off by the abrading action of drift sand while the bone projected from the bed of a watercourse; in other respects it is in excellent preservation. Repeated comparison of this bone with species of dinornis, with dromornis, casuarius, dromæus, struthio, and rhea, has removed from the mind of its describer all doubt of the former existence of the typical moa in Australia. To him it appears to resemble as closely any one of the femurs from New Zealand as any two of these, specifically different, resemble each other, a view which of course implies the absence from it of features notably present in the emu bone. The most important of these is one to which reference has already been made. The "head" of the bone, or that hemispherical projection which fits into the corresponding cavity of the hip-bone, stands out prominently in the moas, in consequence of the neck behind it being somewhat long and of considerably diminished diameter; whereas in the emu the neck is short and thick, so that the limits of the head, especially on its upper surface, are less distinguishable. In this feature, easier to recognize by inspection than by description, dromornis agrees with the emu, while the Queensland moa exhibits the comparatively slender neck and well-defined head of its New Zealand successors. It is not necessary at this moment to insist upon the value of the several characters which aid in the generic identification of this bone with dinornis; they are to be found by any one sufficiently interested in the matter in the "Proceedings" of the Royal Society of Queensland for 1884. To others a recapitulation of them would be tedious.

Unfortunately the identification has not yet been supported by further testimony, a circumstance which can hardly be thought surprising when the extreme slowness with which dinornithic remains have been brought to light is borne in mind: three bones in over half a century has been the rate of discovery hitherto. Adding to these three others from which no precise information can be derived, viz., two ribs provisionally referred to dromornis, and the shaft of a femur too imperfect for determination, but certainly not dromornis, and in all probability not dinornis, all the fossils of this kind known to the writer have been mentioned. In a fairly numerous collection of bones of contemporary birds the paucity of such fossils is conspicuous, but it would hardly be safe to infer from that circumstance that the birds themselves were rare. The most we can say is that they were not among the ordinary frequenters of the lower levels in which the ossiferous drifts of the period were accumulating. It is therefore with sustained eagerness that every fresh tribute of bones is received and inspected, since the hope is always present that they may contain some further proof of the reality of the Queensland moa, as convincing to others as it would be welcome to the assertor.

Be it at the same time observed that there is no reason why a greater amount of proof should be demanded in this case than in others. There is no inherent improbability involved by it so great as to justify inordinate doubt, since the passage of dromornis into dinornis is not so long and difficult a matter as to require for its

accomplishment a new home and a geological remove. The only objection to be raised against it is that it confirms and accentuates the antecedent difficulty created by dromornis itself,—the difficulty of accounting for the presence of moas in New Zealand under their lately existing circumstances. It is not a mystery that they should have been there at all, since it is anything but incredible that a subsidence of ten or twelve thousand feet should—during a geological age which has seen the whole Australian fauna profoundly changed—have taken place in an area liable to volcanic disturbance, such as we see effects of in Australia and feel the throes of in New Zealand. Before that subsidence, Mount Cook, from a height about equal to the Cordilleran peak of elevation, Aconcagua, would have looked down and over continuous land as far as the snow-capped mountains of Queensland, the view unhindered by the intervening peak of Lord Howe's Island,—the refuge of Meiolanian reptiles once in communication with their kinsfolk in Australia. The true difficulty is not the isolation of New Zealand from Australia, but the strange isolation of the moas from all other forms peculiar to Australian life. Why should their stock alone have escaped to an eminence of the sinking surface, or alone been introduced into the insulated land, or alone survived some change in its life-conditions fatal to the rest? The moa in New Zealand is the question that calls for an explanation; and in proof that it does call for an explanation, and is not to be dismissed as a voiceless phantasy, we point to dromornis followed (structurally) by dinornis in Australia, and we wait for its solution in the work of New Zealand's naturalists.

DESTRUCTIVE LOCUSTS.

SINCE the great "grasshopper years" of 1873-76 there have been frequent outbreaks of comparatively local species, as well as a few cases in which small swarms of the Rocky Mountain locust have flown out into the subpermanent region and have occasioned some damage for a year or so. The most notable cases have been the outbreaks of the lesser migratory locust in New Hampshire in 1883 and 1889, the extraordinary multiplication of the devastating locust in California in 1885, the increase of local species in Texas in 1887, the multiplication of a chance swarm of the Rocky Mountain species in a restricted locality in Minnesota in 1888, and last year's damage in Idaho by several non-migratory species combined.

For a number of years the first and second reports of the United States Entomological Commission, which contained the results of the labors of the commission upon the Rocky Mountain locust, have been out of print, and yet with every renewed alarm caused by locusts there has been a great demand upon the entomological division of the United States agricultural department for information, which could only be supplied by correspondence or by publishing the information in local newspapers. For a time the demand was filled by supplying the annual report of the department for 1877, which contained bodily the chapters upon remedies from the first commission report. The supply of this document was also soon exhausted.

The fact that Mr. Bruner, in his last summer's trip to Idaho, investigated the latest rumors, and found that considerable damage was being done, and that the farmers were not acquainted with even the most rudimentary measures for protection and remedy, showed the necessity of publishing a condensed and practical account of the species which become seriously injurious from time to time, and of republishing in as brief form as possible the matter on remedies and preventives from the reports mentioned. The result is the publication by the government of a bulletin on "Destructive Locusts," prepared by Professor C. V. Riley, government entomologist. This bulletin is, in fact, a reproduction of matter already published but now inaccessible for dissemination, and which, from its nature, has a permanent value, together with such additional facts as subsequent experience has revealed. It contains no technical matter whatsoever, and the farmer will be able to recognize the different species from the figures which accompany the consideration of each.

The portion which relates to remedies, while drawn up for use against the Rocky Mountain locust, will apply in large part to

other migratory locusts, as well as to the non-migratory species. Detailed descriptions of the various machines which were given in the original reports are, for the most part, omitted, in the belief that the figures themselves will be sufficiently suggestive for the purpose. In point of fact, many of these machines, especially the more complicated, while serviceable, cannot be recommended to the average farmer dealing with the locust plague, and experience has shown that those simple forms providing for the use of coal-oil and coal-tar are, on the whole, the most efficacious against the unfledged insects. It is, therefore, to this portion of the bulletin that Professor Riley particularly calls the attention of those needing the information contained in it. But little experience of practical value has been had since the last great invasion; hence little has been added to this section of the bulletin beyond a brief description of the trapping system used in Cyprus against the migratory locusts of the Old World, and an account of the bran-arsenic mash remedy used in California in 1885 against the devastating locust.

THE TREES OF TASMANIA.

THE government of Tasmania has recently issued a publication, the "Tasmanian Official Record," which contains much useful and interesting information concerning the trees of that island. It is peculiarly a forest country, and many of the trees are of great dimensions, towering over and eclipsing the lesser undergrowths on plains, valleys, hills, and mountain slopes. Of the 16,778,000 acres comprising the total area, there are only 75,000 acres occupied by lakes, and 488,354 acres of cultivated land only partially cleared of its timber. With the exception of minor areas on the tops of mountains or among the barren uplands of the western highlands, the whole of the rest of the country is occupied with an almost continuous virgin forest, mainly composed of the various forms of eucalypti (gum trees), one noted example of which, the Iolosa blue gum, has been recorded as measuring 330 feet high. Many of these trees have stems measuring 150 feet high without a branch, with a girth of about 40 feet towards the base; and it is also recorded that a blue gum at Southport (*Eucalyptus globulus*), the prevailing tree towards the south of the island, "contained as much timber as would fully suffice to build a 90-ton schooner."

With such a wealth of forest trees, Tasmania's sources of timber supply must be infinitely great, and in the near future must be of great industrial value; but the difficulties of transit, the ignorance of their economic value in distant markets, the plethora of local supply, and the necessity for clearing the land in the most convenient way, all tend, it is said, to produce waste and improvidence in respect of timber products, which might soon become a great source of national wealth.

The necessity for the better conservation of the natural forests in Tasmania has lately commanded the attention of the local government, and a department has been created for the purpose of establishing conserved areas, and for regulating all matters connected with the cutting of timber on government lands.

The following is a description of the more important timbers as regards their industrial value. The blue gum has its home principally in the southern parts of Tasmania, where it attains great dimensions. Many of these trees exceed a height of 280 feet, with a girth of from 40 to 50 feet. A tree called "Lady Franklin's tree," near Hobart, is stated to have a circumference of 107 feet at a height of four feet from the ground. The timber of the blue gum is of rather a pale color, hard, heavy, strong, and durable. In transverse strain its strength is about equal to English oak. It is used in house and ship building, and also by carriage builders and manufacturers of tools.

The "peppermint tree" has a wide range, as it is found in the southern and eastern humid districts of Victoria and New South Wales, as well as in Tasmania. It varies greatly with altitude, climate, and soil, and is found at all heights up to 4,000 feet elevation. In the poorer lands the trees, though tall, are not remarkably so, but in the deep wooded gullies and in the moist ravines of mountains it attains such remarkable dimensions that it has obtained the distinction of the "giant eucalyptus" of Aus-

tralia. The timber of this tree is useful for many kinds of carpenters' work, as in drying it does not split. It is also used in ship-building, for keelsons and planking. Besides its timber, this tree is famous for other products of value. The ashes of the foliage yield, it is stated, ten per cent pearlash; and from one thousand pounds of fresh leaves, with their small stalks and branches, the yield of eucalyptus oil by far surpasses all that of other congeners, amounting to five hundred ounces per thousand pounds.

The stringy-bark gum is a valuable tree, found in abundance in Victoria, South Australia, and Tasmania. It is straight stemmed and of rapid growth, attaining a maximum height of 300 feet. The wood of this tree supplies a large portion of the ordinary sawn hard timber for rough building purposes. It is also well adapted for carriage, cart, and wagon building, wheelwork, and agricultural machinery, as well as for the framing of railway carriages and trucks. The white gum, or "manna tree," is abundantly distributed throughout the island, and has also a wide distribution on the mainland of Australia. Its timber is used for shingles, rails, and for rough building materials. The small branching trees on open ridges and plains are noted for exuding a sugary substance called "manna," which is esteemed a great luxury, and is eagerly sought for by the young.

The gum-topped stringy bark is held in high esteem in Tasmania, and the chief peculiarity of this tree is that, while the lower part of the butt is clothed with a thick fibrous bark, the upper part and the smaller limbs and branches are quite smooth. The timber from this tree is highly prized, and it is described by competent authorities as second only to the blue gum. The iron bark is a valuable tree attaining a height of 150 feet. The trunk is sawn into good timber, and it is also used for posts and rails.

One of the most handsome of the native trees is the blackwood, which is widely distributed along the slopes of the north-west coast. It attains a height of from 60 to 130 feet. The timber is of a brownish color, closely striped with streaks of various shades of a reddish brown. The more ornamental logs of this wood are exceedingly beautiful, and fetch a high price. The myrtle or beech is common in Tasmania, and forms a large proportion of the forests. The "huon" pine is said to be the grandest and most useful of all the soft woods. It is abundant along the rivers of the south-western parts of the island, attaining a height of from 60 to 120 feet, with a diameter of three to eight feet. Its timber is almost indestructible in any situation. It is largely employed, locally, for all kinds of furniture and ornamental work, and is the most highly-esteemed of all kinds of wood for the lighter sea craft. Among the other trees of Tasmania may be mentioned the red pine, oyster bay pine, silver wattle, black wattle, and native cherry.

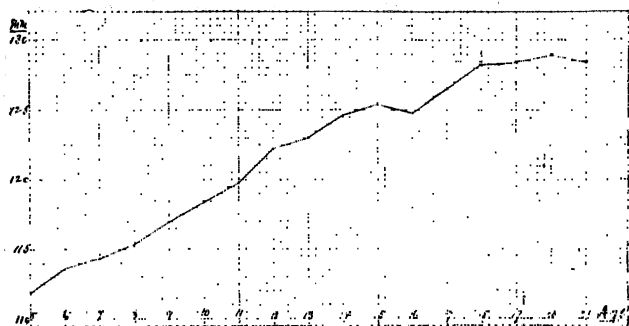
LETTERS TO THE EDITOR.

Growth of the Face.

DURING the past year investigations upon the physical growth of children have been conducted in the Worcester schools. The preliminary tables on the growth of the female face bring out some facts of considerable interest. There seem to be three distinct periods, the first ending about the seventh year, and the third beginning about the fifteenth year. A striking peculiarity is the seemingly abrupt transition from the types of one period to those of the succeeding. The sudden disappearance of the lower widths of face, and the equally sudden appearance of the types of the succeeding period, e.g., the sudden shooting up of the widths to almost adult dimensions at about the age of eight or nine offset by the equally sudden disappearance of the distinctively childish characteristics at the age of eleven. These peculiarities also appear at the ages of twelve and fourteen respectively in the succeeding period. This would seem to indicate the very slow growth of some children until the ages of about eight and fourteen respectively are reached, and then a very rapid development of each individual to her proper position in the series. This Axel Key found also to be true with respect to the total height of the Swedish children observed by him.

In the second period very many of the forms are already adult, and, if not at their fullest development, have very nearly ap-

proached it. From the fifth to the tenth year inclusive the growth is somewhat slow, about 6.5 millimetres in all, but for the next four years, the period of adolescence, the growth is 6.2 millimetres. From the fourteenth year on there is very little advance, the maxi-



mum seeming to be reached at about 128 millimetres in the twentieth year.

On comparing this growth with that of the male face some differences are noticeable. The male face is, with perhaps a single exception, larger for the same period of life and for the same years:

Millimetres.	Age in Years.																
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
100-101	1																
102-103				1													
104-105	1		2	1													
106-107	2	4	2	3		2											
108-109	3	4	2	4	3	1											
110-111	6	14	9	8	6	4	4										
112-113	8	13	20	12	9	5	5	3	1	3							
114-115	9	10	16	13	14	16	12	4	4	1							
116-117		10	15	9	19	18	15	13	6	1		1					
118-119	1	5	13	18	14	25	22	14	10	6	1	1			1	1	1
120-121		1	4	8	11	23	18	14	16	9	5	2	1	1	1		2
122-123				7	3	15	19	18	13	14	8	4	1		1	3	2
124-125	1			1	4	5	14	22	20	18	9	8	2	3	4	3	5
126-127					3	3	6	11	15	15	10	3	2		4	7	5
128-129						1	.5	5	4	7	9	3	2	2	6	3	3
130-131					1			4	6	5	2	1	1	4	6	3	4
132-133						1		1	3	3	1		1	1	3	2	6
134-135								2	1	3	1	1		1	1	2	5
136-137										2					2	1	
138-139								1								1	
140-141																	
142-143																1	
Totals.	32	61	82	84	86	119	115	112	99	87	46	24	10	12	29	27	33
Averages.	111.9	113.6	114.3	115.3	117.0	118.4	119.7	122.3	123.0	124.6	125.4	124.7	126.5	128.2	128.4	128.8	128.4

it appears to grow more rapidly and continues to grow later in life. Massing the cases after twenty, the advance is seen to be far beyond the breadth attained at nineteen, rising to about 138 millimetres. At about nine years the two types approach very near, and it is not at all unlikely that, as found in the case of height by Bowditch in Boston and Peckham in Milwaukee, the female face may for a short period become the broader. Further investigations will be required to determine this point, the present investigation having been made on not more than twenty-five hundred persons, including both sexes.

GERALD M. WEST.

Clark University, Worcester, Mass., June 18.

BOOK-REVIEWS.

The Evolution of Marriage and of the Family. By CH. LETOURNEAU. New York, Scribner. 373 p. \$1.25.

AMONG the distinguished French students of sociology, Professor Letourneau has long stood in the first rank. He approaches the great study of man free from bias and shy of generalizations. To collect, scrutinize, and appraise facts is his chief business. In the volume before us he shows these qualities in an admirable degree. The subject is one of the most vital in social dynamics, for the relation of the sexes is the foundation of primitive society, and on primitive rests and grows all higher social development.

He dismisses as unfounded the extravagant views of McLennan, Lubbock, and our own countryman, Morgan, who would identify primitive marriage with sexual promiscuity. Here, as elsewhere, his opinions are based not merely on the facts of ethnography, but on numerous analogies drawn from the higher orders of the animals inferior to man: for Letourneau holds, along with all other leading ethnographers, that in the senses and emotions man reveals no other distinction above the beast than one of degree, nowhere one of kind; and to understand the motives and customs of the savage state, more is learned from the brute than from the civilized man.

His range of comparison covers all races and extends over all conditions of society. At the close of his attractive pages he ventures to forecast the future of the institution of marriage. He believes that it will be a merely civil contract, monogamous in character, easily contracted, and freely dissolved by simple mutual consent of the contracting parties. Something very near this is already the case in the more enlightened of the Swiss cantons and of the United States. The utmost facility of divorce, with proper guarantees for the interest of the parties concerned,—children and parents,—is the condition to which this work, as well as other unprejudiced studies of the marital relation, unfailingly point.

AMONG THE PUBLISHERS.

THE agitation in the religious world has now come around to the point which is treated in "An Honest Hypocrite," a novel by the Rev. E. Staats DeGrote Tompkins, published by the Cassell Publishing Co.

— G. P. Putnam's Sons have just issued "Politics and Property; or, Phronocracy," a treatise on a compromise between democracy and plutocracy, by Slack Worthington.

— Professor Lanciani contributes to the July number of the *Atlantic Monthly* a paper on "Underground Christian Rome," in which he tells of the discovery of the Christianity of an ancient Roman family from the excavation of their ancient burial place. This is followed by "The Old Rome and the New," sufficiently described in its title, by Mr. W. J. Stillman; a paper by Bradford Torrey on the "Male Ruby-Throat;" the "Story of a Long Inheritance," by William M. Davis, which, though no one would ever suspect it, is devoted to tornadoes. Mr. Nathaniel Southgate Shaler's paper on "College Examinations," which will excite remark, is among the other features of the number.

— A valuable book for all interested in the numerous applications of electricity is T. O'Connor Sloane's "Arithmetic of Electricity" (New York, Henley & Co. \$1.). It is a practical treatise on electrical calculations of all kinds, reduced to a series of rules in simple form, and involving only the use of ordinary arithmeti-

cal methods. Each rule is illustrated by one or more practical problems, with a detailed solution of each one. There is also an extensive series of tables, covering pretty thoroughly the field of electrical work. It may be added, that, in addition to the arithmetical solutions of the problems, there is given after each rule, wherever practicable and useful, the usual algebraic formula.

— In the *Century* for July Professor Edward S. Holden of the Lick Observatory has a paper on popular astronomy, entitled, "A Lunar Landscape," with pictures from negatives taken at the Lick Observatory.

— In their series of introductory science text-books, Macmillan & Co. have published "An Introduction to the Study of Botany," by Edward Aveling, fellow of University College, London. The volume is intended as a guide to the study of botany, and assumes on the part of the reader no knowledge of the subject. While in its general plan the work is based on the syllabus of the science and art department at South Kensington, it cannot fail to prove helpful to all who take up the study of botany, no matter what special end they may have in view. The book has 271 illustrations, and a glossary of over six hundred words. A novel feature is that the pronunciation in English is given of every Greek word used to show the derivation of the botanical terms.

— Henry Holt & Co. will publish early in September a complete "Text-Book of Elementary Physics," chiefly experimental, by Edwin H. Hall, assistant professor of physics in Harvard College

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— Macmillan & Co., the publishers of Mr. Joseph Pennell's "Pen Drawing and Pen Draughtsmen," will issue in July a book by the same author, descriptive of the River Thames, under the title "The Stream of Pleasure."

— Cassell Publishing Co. have ready "The Letters of Marie Bashkirtseff," which, by special arrangement with Madame Bashkirtseff, the mother of the writer, and the French publishers, are published in this country before their appearance in France. An-

dré Theuriet, the editor of the "Journal of Marie Bashkirtseff," has edited these letters also. The book is uniform in typography and binding with the "Journal," and contains new portraits of Marie, with reproductions from her sketches, besides other illustrations.

— D. C. Heath & Co., Boston, will issue very soon, "Studies in United States History," for use in grammar schools, by Mary Sheldon Barnes, author of the "Studies in General History," and Earl Barnes, professor of history in Stanford University, California.

— For the *New England Magazine* for July, Professor J. L. Ewell of Howard University, Washington, writes on "Schliemann's Discoveries in Hellas;" and William M. Salter, in "Emerson's Views on Reform," shows what a radical the Concord philosopher was, and how few of the most advanced reformers of to-day are as advanced as he was in his ideas of social comity.

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